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National Priority Chemicals Trends Report (2005-2007)

Section 4 Trends Analyses for Specific Priority Chemicals (2005-2007): Polycyclic Aromatic Compounds (PACs)

Program Implementation and Information Division
Office of Resource Conservation and Recovery
U.S. Environmental Protection Agency

Contact Information:

Bill Kline, Senior Data Analyst
Information Collection & Analysis Branch
(540) 341-3631
kline.bill@epa.gov

Tammie Owen, Data Analyst
Information Collection & Analysis Branch
(703) 308-4044
owen.tammie@epa.gov

Dwane Young, Chief
Information Collection & Analysis Branch
(703) 347-8578
Young.dwane@epa.gov

Polycyclic Aromatic Compounds (PACs)

Chemical Information

PACs, also known as polycyclic aromatic hydrocarbons (PAHs), are a group of more than 100 different chemicals that are characterized by hydrogen and carbon arranged in two or more fused benzene rings. As pure chemicals, PACs generally exist as colorless, white, or pale yellow-green solids. The polycyclic aromatic compounds category (TRI Category N590) consists of 21 specific chemicals reportable to TRI.

Polycyclic Aromatic Compounds in TRI Category N590	
1-Nitropyrene	Benzo(k)fluoranthene
3-Methylcholanthrene	Benzo(r,s,t)pentaphene
5-Methylchrysene	Dibenz(a,h)acridine
7,12-Dimethylbenz(a)anthracene	Dibenz(a,j)acridine
7H-Dibenzo(c,g)carbazole	Dibenzo(a,e)fluoranthene
Benzo(a)anthracene	Dibenzo(a,e)pyrene
Benzo(a)phenanthrene (chrysene)	Dibenzo(a,h)anthracene
Benzo(a)pyrene	Dibenzo(a,h)pyrene
Benzo(b)fluoranthene	Dibenzo(a,l)pyrene
Benzo(j)fluoranthene	Indeno(1,2,3-cd)pyrene
Benzo(j,k)fluorene (fluoranthene)	

General Uses: Most, if not all, PACs are byproducts of combustion or impurities. They are produced or emitted during thermal processes, such as the incomplete combustion of organic compounds, pyrolysis, or the processing of fossil fuels, bitumens, or nonfossil fuels. There are presently no known commercial uses for PACs.

How Much Polycyclic Aromatic Compounds Were Generated?

For 2007, 709 facilities reported approximately 10.2 million pounds of PACs being generated; two facilities accounted for approximately 57 percent of the national total quantity of this PC, while 15 facilities accounted for approximately 90 percent (please refer to Exhibit 3.4 to see the number of facilities that reported this PC within various quantity ranges). Compared to the total quantities of PACs reported for 2005 and 2006, the quantity increased by approximately 1.1 million pounds and increased by approximately 2.2 million pounds, respectively (Exhibit 4.67).

Exhibit 4.67. National Generation of Polycyclic Aromatic Compounds (2005–2007)

TRI Reporting Year	2005	2006	2007
Total Quantity of Polycyclic aromatic compounds (pounds)	9,076,991	7,967,837	10,211,230
Number of TRI Facilities Reporting Polycyclic aromatic compounds	709	703	709

Where Were Polycyclic Aromatic Compounds Generated?

For 2007, facilities in 53 states and territories reported generating PACs. Exhibit 4.68 shows the counties in which facilities reported approximately 90 percent of the total quantity of PACs. Some observations concerning the quantity of PACs reported by facilities in these counties are:

- A carbon black manufacturing facility in Orange County, Texas (EPA Region 6) reported an increase of approximately 3.3 million pounds for 2007. The facility attributes this increase to the start-up of a cogeneration power plant.

- A primary aluminum production facility in Hancock County, Kentucky (EPA Region 4) reported an increase of approximately 958,000 pounds for 2006, followed by an increase of 444,000 pounds for 2007. This facility uses coal tar pitch and coke to produce carbon rods (anodes) for aluminum smelting. PACs are contained in the coal tar pitch bought from an off-site source. In 2006, the facility changed its coal tar pitch vendor, resulting in a change in composition of the coal tar pitch. The quantities of PACs generated also correlate with the production of carbon rods.
- A carbon and graphite product manufacturing facility in Maury County, Tennessee (EPA Region 4) reported decreases of approximately 967,000 pounds and 721,000 pounds for 2006 and 2007, respectively. This facility uses coal tar pitch for producing carbon electrodes and changed its coal tar pitch vendor, resulting in a change in composition of the coal tar pitch. The quantities of PACs generated also correlate with the production of carbon rods.
- A carbon and graphite product manufacturing facility in Pope County, Arkansas (EPA Region 6) reported an increase of approximately 242,000 pounds for 2006 followed by a decrease of approximately 545,000 pounds for 2007 due to changes in feedstock and production rate.
- A chemical manufacturing facility in Scioto County, Ohio (EPA Region 5) that had reported approximately 358,000 pounds for 2005 did not report any PACs in 2006 or in 2007. Previous to 2006, the facility considered the waste fuels used to fire boilers to be similar in composition and combustion to fuel oil. Thus, the quantity of PACs was based either on fuel oil #2 or fuel oil #6. For the 2006 and 2007 reporting years, the facility process engineers determined that the waste fuel was not equivalent to fuel oil and that PACs would not be generated from burning the waste fuels. As such, the facility updated its threshold determination to only take into account the PACs generated from combustion of diesel and natural gas.
- A miscellaneous chemical product and preparation manufacturing facility in Mayes County, Oklahoma (EPA Region 6) did not report PACs for 2005 but reported approximately 551,000 pounds for 2006 and 613,000 pounds for 2007.
- A petrochemical manufacturing facility in Wayne County, Michigan (EPA Region 5) had reported approximately 307,000 pounds for 2006 as a result of activities associated with shutdown and cleanup operations, including residuals from tank cleanouts. The facility began shutdown and cleanup operations in May 2004 and completed the shutdown 2006.
- A petrochemical manufacturing facility in Brooke County, West Virginia (EPA Region 3) reported a decrease of approximately 165,000 pounds for 2006. The PACs come mainly from the coal tar pitch. This facility produces waste coal tar pitch in the production of pencil pitch (pitch extruded into a water bath that forms long solid rods that look like pencils) that is conveyed to pans for loading. Most of the material disposed of falls off the conveyers and lands on the pavement. Due to potential contamination with dirt or rocks on the pavement, none of this material that reaches the pavement is shipped to customers and must be disposed of.
- A cyclic crude and intermediate manufacturing facility in Harris County, Texas (EPA Region 6) reported decreases of approximately 139,000 pounds and 582,000 pounds for 2006 and 2007 respectively that likely resulted from substituting a cleaner feedstock.
- A petrochemical manufacturing facility in Allegheny County, Pennsylvania (EPA Region 3) reported an increase of approximately 153,000 pounds for 2007. The facility noted that waste shipped off site from its facility contain coal tar or petroleum based pitch and that a number of factors influence this quantity including, but not limited to, spills, off spec product, solid pitch production levels, storage tank cleaning projects, and if any of the solid pitch rail cars need cleaning when they are returned from customers.
- A carbon and graphite product manufacturing facility in Burke County, North Carolina (EPA Region 4) reported a decrease of approximately 690,000 pounds for 2006 followed by a decrease of approximately 61,000 pounds for 2007. This facility uses coal tar pitch for producing carbon electrodes. The quantities of PACs generated correlate with the production of carbon rods; the facility also noted the composition of the coal tar pitch changed, as supplied by its vendor. For 2007, the facility had reduced production; the quantities reflect reduced manufacturing output.
- A petroleum refinery in Calcasieu County, Louisiana (EPA Region 6) reported an increase of approximately 236,000 pounds for 2007. The facility noted they changed how they calculate the destruction efficiency when material was sent to the flare. The facility previously used emissions data; now are calculating numbers for streams to the flare.

Exhibit 4.68. Quantity of Polycyclic Aromatic Compounds, for Facilities Reporting 90 Percent of Total Quantity, by County (2007)

EPA Region	State	County	Quantity (pounds) of PACs			Percent of Total Quantity (2007)
			2005	2006	2007	
6	TX	Orange	638	0	3,252,768	31.9%
4	KY	Hancock	1,171,896	2,129,500	2,569,900	25.2%
6	OK	Mayes	0	551,117	613,429	6.0%
5	IN	Lake	462,774	482,522	479,800	4.7%
6	AR	Franklin	371,159	447,882	444,155	4.3%
4	KY	Fulton	327,672	339,742	354,761	3.5%
6	AR	Pope	628,392	870,098	325,799	3.2%
6	LA	Calcasieu	114,279	81,184	312,558	3.1%
4	NC	Burke	1,010,636	320,713	260,061	2.5%
3	PA	Allegheny	82,628	1,460	155,126	1.5%
4	SC	Berkeley	135,408	132,110	132,010	1.3%
3	WV	Brooke	305,310	140,494	110,353	1.1%
4	GA	Bartow	0	0	84,112	0.8%
6	TX	Nueces	177,787	153,664	82,991	0.8%
Total			4,788,577	5,650,486	9,177,823	89.9%

Which Industries Generated Polycyclic Aromatic Compounds?

For 2007, facilities in 75 different NAICS codes reported generating PACs. Facilities in three NAICS codes: NAICS code 325182 (Carbon Black Manufacturing), NAICS code 331312 (Primary Aluminum Production), and NAICS code 335991 (Carbon and Graphite Product Manufacturing) accounted for approximately 74 percent of the total quantity of PACs generated (Exhibit 4.69).

Exhibit 4.69. Industry Sectors Quantities of Polycyclic Aromatic Compounds, for Facilities Reporting 95 Percent of Total Quantity (2007)

Primary NAICS Code	NAICS Code Description	Facilities Reporting (2007)	Quantity (pounds) of PACs			Percent of Total Quantity (2007)
			2005	2006	2007	
325182	Carbon Black Manufacturing	19	27,573	5,890	3,257,834	31.9%
331312	Primary Aluminum Production	10	1,341,676	2,264,506	2,722,433	26.7%
335991	Carbon and Graphite Product Manufacturing	19	4,220,588	2,899,886	1,586,338	15.5%
325998	All Other Miscellaneous Chemical Product and Preparation Manufacturing	9	15,483	572,424	636,112	6.2%
324191	Petroleum Lubricating Oil and Grease Manufacturing	2	481,117	501,738	502,274	4.9%
324110	Petroleum Refineries	86	341,527	264,406	407,276	4.0%
325110	Petrochemical Manufacturing	11	721,140	226,270	362,301	3.5%
325211	Plastics Material and Resin Manufacturing	8	203,925	138,281	142,418	1.4%
325192	Cyclic Crude and Intermediate Manufacturing	5	811,619	668,368	101,611	1.0%
Total		169	8,164,648	7,541,770	9,718,597	95.2%

How Did Facilities Manage Polycyclic Aromatic Compounds?

Exhibit 4.70 shows how facilities, by industry, managed PACs in 2007.

Disposal: Facilities disposed of approximately 5 percent of the PACs generated, primarily off site. Facilities in NAICS code 325110 (Petrochemical Manufacturing) accounted for approximately 54 percent of the total quantity of PACs disposed of, including 74 percent of its PACs generated.

Energy Recovery: Facilities used energy recovery to manage approximately 39 percent of the PACs generated. Facilities in NAICS code 325182 (Carbon Black Manufacturing) and NAICS code 325998 (All Other Miscellaneous Chemical Product and Preparation Manufacturing) used energy recovery as their primary method of managing PACs.

Treatment: Facilities treated approximately 56 percent of the PACs generated. Facilities in 5 of the 9 industries used treatment as their primary method for managing this PC.

In 2007, facilities also recycled approximately 3 million pounds of PACs. See Exhibit C.3 in Appendix C for additional information about the recycling of PACs. Facilities also released approximately 197,000 pounds of PACs as air emissions and surface water discharges in 2007. See Appendix D for additional information about releases of PACs.

Exhibit 4.70. Management Methods for Polycyclic Aromatic Compounds, by Industry (NAICS Code) in 2007

Primary NAICS Code	NAICS Code Description	Total PC Quantity Reported	Quantity (pounds) of PACs					
			Disposal		Energy Recovery		Treatment	
			On-site	Off-site	On-site	Off-site	On-site	Off-site
325182	Carbon Black Manufacturing	3,257,834	173	2,000	2,753,798	0	501,383	479
331312	Primary Aluminum Production	2,722,433	6,147	57,900	0	0	2,655,697	2,689
335991	Carbon and Graphite Product Manufacturing	1,586,338	4,410	25,193	393,225	2	1,161,679	1,829
325998	All Other Miscellaneous Chemical Product and Preparation Manufacturing	636,112	1,684	18,345	611,745	920	3,400	18
324191	Petroleum Lubricating Oil and Grease Manufacturing	502,274	0	22,611	0	0	479,654	9
324110	Petroleum Refineries	407,276	3,632	19,434	1,164	6,793	359,919	16,335
325110	Petrochemical Manufacturing	362,301	2,476	264,459	0	772	90,497	4,098
325211	Plastics Material and Resin Manufacturing	142,418	728	104	18,378	0	123,208	0
325192	Cyclic Crude and Intermediate Manufacturing	101,611	0	64,055	22	25,654	41	11,839
Total		9,718,597	19,251	474,100	3,778,332	34,140	5,375,478	37,296

Data Derived From Hazardous Waste Biennial Reports for Polycyclic Aromatic Compounds

In this section, we present data about PACs contained in hazardous wastes, derived from information submitted by facilities in Biennial Reports under RCRA. We derived these data by applying a methodology to estimate the quantity of PACs contained in BR waste streams. The quantities shown below were aggregated for seven chemicals within the PAC category: benzo(a)anthracene, benzo(a)pyrene, benzo(b)fluoranthene, benzo(k)fluoranthene, benzo(rst)pentaphene, dibenzo(a,h)anthracene, and indeno[1,2,3-cd]pyrene. The estimates of PACs contained in hazardous wastes supplement the data reported to TRI, providing a broader perspective regarding the industries that generate and manage wastes that contain PACs. Based on applying our methodology to the 2007 BR data, we estimate that 292 facilities in 50 NAICS codes reported hazardous wastes, virtually all non-wastewater, containing approximately 818,000 pounds of PACs. Facilities in two industries: NAICS code 32411 (Petroleum Refineries) and NAICS code 325192 (Cyclic Crude and Intermediate Manufacturing) accounted for approximately 84 percent of the total quantity of PACs in the hazardous waste streams (Exhibit 4.71).

Exhibit 4.71. Estimated Quantity of Polycyclic Aromatic Compounds in Primary Generation Hazardous Waste, by NAICS Code (2007)

Primary NAICS Code	NAICS Code Description	Number of Facilities	Quantity (pounds) of PACs			Percent of Total Quantity
			Wastewaters	Non-Wastewaters	Total Quantity	
324110	Petroleum Refineries	140	74	479,193	479,267	58.6%
325192	Cyclic Crude and Intermediate Manufacturing	7	0	206,320	206,320	25.2%
331312	Primary Aluminum Production	15	261	60,552	60,813	7.4%
321114	Wood Preservation	54	149	23,763	23,912	2.9%
221210	Natural Gas Distribution	1	0	14,069	14,069	1.7%
812990	All Other Personal Services	1	0	8,676	8,676	1.1%
331315	Aluminum Sheet, Plate, and Foil Manufacturing	2	0	7,000	7,000	0.9%
Total		220	484	799,573	800,057	97.8%

In 2007, facilities generated hazardous waste containing PACs in 194 counties within 42 states and territories. Facilities in Jefferson County, Alabama (EPA Region 4) generated an estimated 25 percent of the PACs contained in hazardous wastes (Exhibit 4.72).

Exhibit 4.72. States and Counties in Which Facilities Generated 80 Percent of Polycyclic Aromatic Compounds Contained in Primary Generation Hazardous Waste (2007)

EPA Region	State	County	Estimated Quantity of PACs Contained in Hazardous Wastes (pounds)	Percent of Total Quantity of PACs Contained in Hazardous Wastes
4	AL	Jefferson	202,423	24.7%
6	TX	Jefferson	91,234	11.2%
6	TX	Brazoria	80,888	9.9%
6	OK	Kay	52,477	6.4%
5	IL	Crawford	51,481	6.3%
5	OH	Lucas	50,607	6.2%
9	CA	Solano	24,206	3.0%
5	IN	Marion	14,069	1.7%
9	CA	Los Angeles	13,293	1.6%
6	TX	El Paso	11,517	1.4%
9	CA	Contra Costa	10,654	1.3%
8	WY	Carbon	10,638	1.3%
6	TX	Milam	10,155	1.2%
6	TX	Harris	9,994	1.2%
5	IL	Madison	9,382	1.1%
3	PA	Mckean	8,858	1.1%
Total			651,876	79.7%

Exhibit 4.73 shows how facilities reported managing hazardous wastes that contain PACs. For example, facilities used fuel blending for an estimated 395,000 pounds of PACs and incinerated an estimated 109,000 pounds of PACs. See Appendix E for a full list of the BR management codes and their descriptions.

Exhibit 4.73. Methods Used to Manage Hazardous Wastes Containing Polycyclic Aromatic Compounds (2007)

Management Method Group	Management Method Code Description	Quantity of PACs Managed (2007)	Percent of Total Estimated Quantity of PACs
Reclamation and Recovery	Fuel blending prior to energy recovery at another site	395,486	47.6%
	Energy recovery at this site	47,141	5.7%
	Other recovery or reclamation for reuse	11,343	1.4%
	Metals recovery	310	<0.1%
	Solvents recovery	<1	<0.1%
Reclamation and Recovery Total		454,280	54.7%
Destruction or Treatment Prior to Disposal at Another Site	Incineration	109,404	13.2%
	Stabilization or chemical fixation prior to disposal at another site	22,841	2.8%
	Sludge treatment and/or dewatering	4,883	0.6%
	Other treatment	4,171	0.5%
	Biological treatment with or without precipitation	1,231	0.1%
	Chemical oxidation	197	<0.1%
	Phase separation	40	<0.1%
	Macro-encapsulation prior to disposal at another site	5	<0.1%
	Cyanide destruction with or without precipitation	2	<0.1%
Destruction or Treatment Prior to Disposal at Another Site Total		142,774	17.2%
Disposal	Landfill or surface impoundment that will be closed as landfill	112,751	13.6%
	Land treatment or application	4,011	0.5%
	Discharge to sewer/POTW or NPDES	148	<0.1%
	Deepwell or underground injection	125	<0.1%
Disposal Total		117,035	14.1%
Transfer Off Site	Storage, bulking, and/or transfer off site	115,282	13.9%
Transfer Off Site Total		115,282	13.9%
NA	NA	640	0.1%
NA Total		640	0.1%
Grand Total		830,011	100.0%